ANDERCO SAFETY

1

GAS MONITORING

Q01002

Q01002

Biosystems MultiPro™

- *Compact confined space gas detector with real-time readings for up to 4 gases.*
- *O_2, LEL and a choice of CO, H_2S or Biosystem's Duo-Tox two-channel.*
- *Field replaceable sensor.*
- *One button operation (including calibration).*
- *Calibration due reminder.*
- *Sensor span reserve indicators for predictive maintenance.*
- *Built-in event logger capable of storing information for 20 events including sensor type, maximum and average readings, time and duration.*
- *Front-mounted backlit graphic display.*
- *IrDA port for communication with PC.*
- *Exceeds IEC 1000-4-3 for level 3 RFI immunity specifications.*
- *Warning, danger, STEL and TWA alarms.*
- *Available with either a Li-Ion or Alkaline battery pack and offers run times of up to 22 hours.*
- *Compatible with IQ Controller and MultiPro IQ Express Calibration Stations.*

SHIPS FROM STOCK

Q01003

Q01003

Biosystems Toxi Vision IR CO_2

- *Fully serviceable, compact, rugged gas detector.*
- *Infrared sensor for the detection of Carbondioxide (CO_2).*
- *PX7 rated protection against water ingress.*
- *One button operation.*
- *Programmable Warning, Danger, STEL and TWA alarms.*
- *RFI immunity to 40 V/m.*
- *Top and front mounted bright LED.*
- *Event logger.*
- *Available with either a NiMH or Alkaline battery.*

Q01001

Q01001

Biosystems Toxi Vision EX

- *Rugged, nickle plated, single sensor gas monitor for the detection of combustible gas.*
- *One button operation, including calibration.*
- *Utilises a poison-resistant catalytic bead sensor which increases sensor longevity.*
- *RFI shileding prevent operating interference from two-way radios and other electronic devices.*
- *Up to 13 hour life with alkaline battery and 15-hours life for rechargeable battery.*
- *IPX7 rated against water ingress (alkaline version only).*
- *Event logger and black box recorder are standard on the rechargeable battery version.*
- *Internal vibrating alarm.*
- *Top and front mounted, bright LED.*

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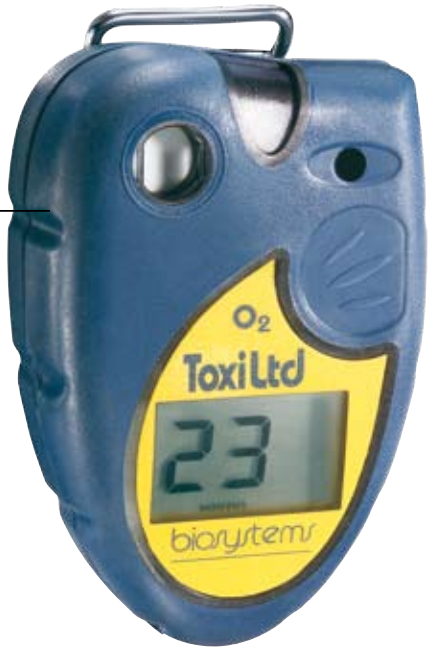
Q02001

Biosystems ToxiLtd

- *Economical, full-featured, disposable single gas monitor.*
- *Compact and rugged.*
- *Available for the detection of O_2, CO, H_2S or SO_2.*
- *Rated to IP65/IP67 against water ingress.*
- *One button operation (including calibration).*
- *Includes an event logger as standard (latest 20 events including sensor type, maximum readings, average readings, time and duration).*
- *Audible alarm.*
- *Top and front mounted bright LED.*
- *Service life indicator.*
- *Exceeds IEC 6100-4-3 for level 3 RFI immunity specifications.*
- *Available with an operating life of either 2 years or 3 years.*

SHIPS FROM STOCK IN 2 YEAR O_2, CO, H_2S

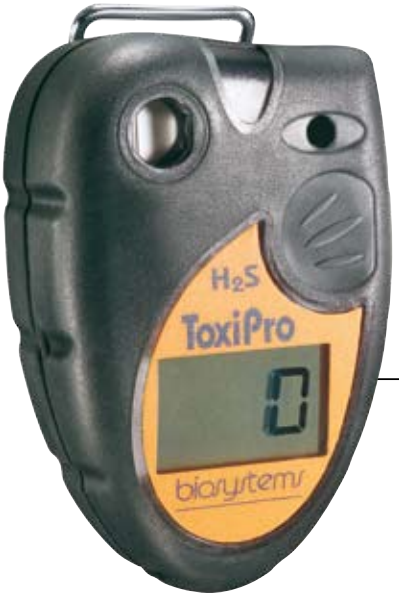


Q02001

Q02002

Biosystems ToxiPro

- *Compact, rugged, serviceable, single gas monitor.*
- *Real-time Peak, STEL and TWA readings as well as a black box data recorder.*
- *Available for the detection of O_2, CO, H_2S, SO_2, CO+, CO-H, C_{12}, NH_3, NO_2, PH_3 or HCN.*
- *Rated to IP65/IP67 against water ingress.*
- *One button operation (including calibration).*
- *Large display and audible alarm.*
- *Standard black box data recorder.*
- *Includes an event logger as standard (latest 20 events including sensor type, maximum readings, average readings, time and duration).*
- *Exceeds IEC 6100-4-3 for level 3 RFI immunity specifications.*
- *IrDA PC communication.*
- *Up to 9000 hours battery life.*
- *Can be used with the IQ Express Docking Station.*
- *Translucent case option for enhanced alarm visibility.*



Q02002

Q03001

Biosystems ToxiPro/Ltd IQ Express

- *Automatic calibration station and data download centre for the ToxiPro and ToxiLtd single sensor gas detectors.*
- *Can be operated as an independent calibration station, connected to a PC (via USB or network) for enhanced control over calibration and data acquisition.*
- *Efficient and economical - bump test in under 20 seconds and calibration in under 1 minute (O2, CO2 and H2S models).*
- *Performs up to 8 critical tests every time an instrument is placed in the dock.*
- *If an instrument fails the bump test, the IQ Express will automatically initiate a full span calibration without further intervention from the user.*
- *Automatic instrument identification.*
- *Automatic battery, alarm and bump tests.*
- *Automatic calibration (if necessary).*
- *Automatic record keeping and ready/fault indication.*

Q03001

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Q03002

Q03002

Biosystems MultiPro IQ Express

- *Automatic calibration station and data download centre for the MultiPro gas detector.*
- *Can be operated as an independent calibration station, connected to a PC (via USB or network) for enhanced control over calibration and data acquisition.*
- *Performs up to 8 critical tests every time an instrument is placed in the dock.*
- *If an instrument fails the bump test, the IQ Express will automatically initiate a full span calibration without further intervention from the user.*
- *Automatic instrument identification.*
- *Automatic battery, alarm and bump tests.*
- *Automatic calibration (if necessary).*
- *Automatic record keeping and ready/fault indication.*

Q01007

Q01007

Biosystems PhD6

- *Reliable, easy to use, multi gas detector.*
- *5 sensor ports and over 19 sensor options including electrochemical, LEL, PID and infrared.*
- *Up to 6 channels of detection.*
- *Enclosed in solid polycarbonate case with rubber overmold for durability.*
- *Available with interchangeable Li-Ion or Alkaline battery packs .*
- *Audible alarm.*
- *Front and side mounted LED alarms.*
- *Status bar with easily recognised symbols.*
- *Intuitive, menu-driven instrument configuration.*
- *Built in IrDA port for easy downloads.*
- *Compatible with IQ6 calibration station.*

Q01004

Q01004

EntryRAE Gas Monitor

- *4 gas monitor (02, LEL, CO, H2S) plus photoionization (PID) detector.*
- *Typical sensor configurations include: 10.6 eV PID sensors installed; LEL/02/10.6 eV PID sensor installed; LEL/02/H2S/CO/10.6 eV PID sensors installed; LEL/02/H2S/CO sensors installed.*
- *Reliable, easy to operate and calibrate.*
- *Self cleaning, VOC detector.*
- *Durable, weather-resistant rubber body.*
- *Automatic data logging included.*
- *Large, backlight display and audible alarm.*
- *Red, flashing LED alarms.*
- *Up to 16 hours continuous operation.*
- *Available with rechargeable / replaceable Li-Ion battery pack and Alkaline battery adapter .*
- *Charging cradle doubles as an external battery charger.*
- *Powerful pump allows sample draws up to 30m.*
- *Low-flow pump alarm.*
- *Computer interface cable.*
- *Calibration adapter.*

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Q01005

MiniRae Gas Monitor

- Portable, handheld volatile organic compounds (VOC) monitor.
- Available with 10.6eV PID sensor, 11.7eV PID sensor or 9.8eV PID sensor.
- Provides 3 second response time, an extended range up to 15,000 ppm with improved linearity, and humidity compensation with integral humidity and temperature sensors.
- Real-time, wireless data transmission with built-in RF modem or Bluetooth - view real-time sensor data and alarm status at headquarters or command centre.
- Designed for simple service with easy access to lamp and sensor in seconds without tools.
- 3 large keys that can be operated while wearing gloves.
- Red, flashing visual alarm and loud audible alarm.
- Large graphic display for easy overview of gas type, correction factor and concentration.
- Available with rechargeable / replaceable Li-Ion battery pack and Alkaline battery adapter .
- Integrated flashlight.
- User-friendly screens, including dataplot chart view.
- Integrated RAE Correction Factors list for over 200 compounds.
- Multi-language support.
- Rugged, waterproof housing and strong, protective rubber boot.
- Data logging with up to 6 months of data at one-minute intervals.
- Strong, built-in sample draw pump.
- Leather carrying case with training CDROM.

Q01006

MultiRae Gas Monitor

- Combines a PID detector with the standard four gases of a confined space monitor (02, LEL and 2 interchangeable toxic gas sensors).
- Wide range of sensor options and configurations. Typical sensor configurations include: LEL/02/ H2S/CO/10.6eV PID sensors installed; LEL/02/10.6 eV PID sensors installed; LEL, 02, H2S/10.6 eV PID sensors installed; LEL/02/CO/10.6 eV PID sensors installed. Customer specific configurations available upon request.
- Compact monitor with sampling pump.
- 0-2,000 ppm measurement of VOCs with 0.1 ppm resolution.
- Over 60 correction factors built in.
- Can be used as a personal monitor, a hand-held sniffer or as a continuous-operation area monitor.
- Wireless communication enabled and certified.
- Optional data logging.
- Provided with shipping case, calibration adapter and training CDROM.
- Rubber boot with belt clip.
- Available with interchangeable Li-Ion or Alkaline battery packs .
- Up to 14 hours continuous operation.
- Drop in battery for additional operating hours.
- Use friendly screen makes it easy to use for simple applications and flexible enough for sophisticated options.
- Large external filter and automatic low flowage.
- Large keys can be operated while wearing gloves.
- Easy-to-read display with back light.
- Loud audible alarm that varies for different alarm conditions and an optional external vibration alarm for noisy areas.

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L10007

L10007

Smiths Detection HGVI

- *Hand-held, multi-sensor gas and vapour identifier for a broad range of toxic industrial chemicals.*
- *Switches automatically between modes.*
- *Multiple sensors (orthogonal techniques) working together in one instrument (IMS, PID and TGS sensors).*
- *Driven by H-Fusion advanced software developed to interpret the results of multiple sensors.*
- *Non-radioactive IMS source.*
- *Gamma radiation detection.*
- *Automatic detection, identification and monitor modes of operation.*
- *Rugged and lightweight.*
- *Easily decontaminated.*
- *Operates in temperature ranges from -14 to 122°F.*
- *Easy-to-see LCD screen with an integrated light sensor that automatically adjusts the backlight based on lighting conditions.*
- *Operates for 8 hours on 1 fully charged battery.*
- *Audible, visual and vibrate alarm modes.*

L10009

L10009

Smiths Detection HazMatID

- *Portable chemical identifier.*
- *Identifies unknown chemical liquids, powders and solids in seconds using Fournier Transform Infrared Spectroscopy.*
- *Measures how chemical samples interact with infrared light.*
- *Database libraries include: toxic industrial chemicals; white powders; explosives and propellants; common chemicals; forensic drugs; pesticides.*
- *No sample preparation required.*
- *Entire system can be submerged in a decontamination solution.*
- *Operates in temperatures ranging from 19°F to 122°F and humidity ranging from 0-100%.*
- *Easy-to-use touch screen operation.*

L10008

L10008

Smiths ResponderR RCI

- *Field portable, Raman spectrometer supported by a 6,000+ spectral library of: common chemicals; white powders; explosives; narcotics.*
- *For fast, accurate detection of unknown chemicals.*
- *Wireless communication to HazMatID.*
- *Point and shoot capability.*
- *Ease of operation in Level A gear.*
- *Waterproof and rugged.*
- *All external parts are resistant to bleach solution.*
- *Long-lasting, rechargeable battery.*
- *Blue tooth enabled with indoor and outdoor capability.*

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BIOSYSTEMS SPARES & ACCESSORIES

Sensors

Multipro

DuoTox Sensor (Dual Channel CO/H2S)	P03003	SHIPS FROM STOCK
O2 Sensor (Oxygen)	Q03004	SHIPS FROM STOCK
LEL Sensor (Combustible Gas)	Q03005	SHIPS FROM STOCK

PHD6

CO Sensor (Carbon Monoxide)	Q03017
H2S Sensor (Hydrogen Sulfide)	Q03018
SO2 Senor (Sulphur Dioxide)	Q03019
CO+ Sensor (non-specific readout for CO & H2S	Q03020
NO Sensor (Nitric Oxide)	Q03021
NO2 Sensor (Nitrogen Dioxide)	Q03022
HCN Sensor (Hydrogen Cyandie)	Q03023
PH3 (Phosphine)	Q03024
DuoTox Sensor (Dual Channel CO/H2S)	Q03025
SO2 Sensor (Sulphur Dioxide – extended range)	Q03026
Cl2 Sensor (Chlorine – specific)	Q03027
CO-H (reduced sensitivity to H2)	Q03028
NH3 (Ammonia)	Q03029
IR-CO2 (Non dispersive infrared carbon dioxide)	Q03030
IR-CH4 (Non dispersive infrared methane)	Q03031
PID Sensor (for VOCs)	Q03032
LEL Sensor (Combustible Gas)	Q03033
O2 Sensor (Oxygen)	Q03034

ToxiPro

O2 Sensor (Oxygen)	Q03035
CO Sensor (Carbon Monoxide)	Q03036
CO+ Sensor (Dual purpose CO/H2S)	Q03037
CO-H (reduced sensitivity to H2)	Q03038
H2S Sensor (Hydrogen Sulfide)	Q03039
SO2 Sensor (Sulphur Dioxide – extended range)	Q03040
NH3 Sensor (Ammonia)	Q03041
Cl2 Sensor (Chlorine – specific)	Q03042
PH3 (Phosphine)	Q03043

Toxi Vision IR

CO2 Sensor (Non Dispersive Infrared)	Q03044

CALIBRATION GASES

34 Litre (CO/H2S, LEL)	Q03006	SHIPS FROM STOCK
58 Litre (CO/H2S, LEL)	Q03007	SHIPS FROM STOCK

A full range of calibration gases are available to order.

OTHER

Case (Foam Lined)	Q03008	SHIPS FROM STOCK
Case (Unlined)	Q03011	SHIPS FROM STOCK
Charger (AC/DC 220v)	Q03009	SHIPS FROM STOCK
3 Pin Charger Plug	Q03010	SHIPS FROM STOCK
Automatic Pump (Multipro)	Q03012	SHIPS FROM STOCK
Multigas Regulator	Q03014	SHIPS FROM STOCK
Ammonia Regulator	Q03015	SHIPS FROM STOCK
IQ Express Demand Flow Regulator	Q03046	SHIPS FROM STOCK
Calibration Adapter (PhD Lite)	Q03047	SHIPS FROM STOCK
Calibration Adapter (Multipro)	Q03048	SHIPS FROM STOCK

RAE SPARES & ACCESSORIES

SENSORS

MultiRAE

- LEL Sensor (Combustible Gas) — Q03049
- O2 Sensor (Oxygen) — Q03050
- H2S Sensor (Hydrogen Sulfide) — Q03051
- CO Sensor (Carbon Monoxide) — Q03052
- SO2 Sensor (Sulphur Dioxide) — Q03053
- NO Sensor (Nitric Oxide) — Q03054
- NO2 Sensor (Nitrogen Dioxide) — Q03055
- CL2 Sensor (Chlorine) — Q03056
- HCN Sensor (Hydrogen Cyanide) — Q03057
- NH3 Sensor (Ammonia) — Q03058
- PH3 Sensor (Phospine) — Q03059
- PID Sensor (10.6 eV) — Q03060
- PID Sensor (11.7 eV) — Q03061
- PID Sensor (9.8 eV) — Q03062

MiniRAE

- PID Sensor (10.6 eV) — Q03063
- PID Sensor (11.7 eV) — Q03064
- PID Sensor (9.8 eV) — Q03065

EntryRAE

- LEL Sensor (Combustible Gas) — Q03066
- O2 Sensor (Oxygen) — Q03067
- H2S Sensor (Hydrogen Sulfide) — Q03068
- CO Sensor (Carbon Monoxide) — Q03069
- PID Sensor (10.6 eV) — Q03070

CALIBRATION KITS

- **MultiRAE Calibration Kit**

  (Four-gas mix in 34L cylinder: 50% LEL, 20.9% Oxygen, 25 ppm Hydrogen Sulfide, 50 ppm Carbon Monoxide; Calibration Regulator(s) and tubing; 1 00 ppm Isobutylene gas in 34L cylinder.) — Q03071

- **MiniRAE Calibration Kit**

  (100 ppm Isobutylene calibration gas in 34L cylinder; Calibration regulator and flow controller.) — Q03072

  In addition, a full range of calibration gases are available to order.

ENTRYRAE CONFINED SPACE KITS

- **Kit 1 -** (Transport case; Tool kit; Sampling wand with 3m Teflon tubing; Four-gas mix in 34L cylinder: 50% LEL, 20.9% Oxygen, 25 ppm Hydrogen Sulfide, 50 ppm Carbon Monoxide; Flow regulator and tubing.) — Q03073

- **Kit 2 -** (Transport case; Tool kit; Sampling wand with 3m Teflon tubing; 100 ppm Isobutylene gas in 34L cylinder; Flow regulator and tubing.) — Q03074

- **Kit 3 -** (Transport case; Tool kit; Sampling wand with 3m Teflon tubing; Four-gas mix in 34L cylinder: 50% LEL, 20.9% Oxygen, 25 ppm Hydrogen Sulfide, 50 ppm Carbon Monoxide; 100 ppm Isobutylene gas in 34L cylinder; Flow regulator and tubing.) — Q03075

ACCESSORIES KITS

- **MultiRAE Accessories Kit**

  (Foam lined transport case; sampling wand with 5m Teflon tubing; Tool kit.) — Q03076

- **MiniRAE Accessories Kit**

  (Foam lined transport case; Charging / download cradle; 5 Porous metal filters and O-rings; Organic vapour zeroing kit; Gas outlet port adapter and tubing.) — Q03077

- **EntryRAE Accessories Kit**

  (Foam lined transport case; Tool kit; sampling wand with 3m Teflon tubing.) — Q03078

SELECTING & USING GAS MONITORING EQUIPMENT

Failure to comply with legislation on the control of atmospheric hazards in the workplace is subject to severe penalties. Local health and safety guidelines dictate safe working practices for personnel who are involved in confined space work or with processes and operations where flammable gases, vapours and toxic substances are present. The same guidelines apply to emergency response teams dealing with chemical spillages, gas leaks etc.

Management of workplace air quality hinges on 2 basic requirements: proper assessment of existing or potential atmospheric hazards, and implementation of procedures to eliminate, control or maintain safe atmospheric conditions. For hazards which cannot be permanently eliminated, it is necessary to monitor to ensure that conditions are safe for employees entering affected areas. Early warning gas detection means that action can be taken to disperse or shut down dangerous levels of gas before it leads to casualties and/or property damage on site and beyond. Consequently, effective gas monitoring is an integral part of any environmental protection and safety program.

Atmospheric Hazards Commonly Encountered in Industry

Wastewater - atmospheric hazards are primarily encountered during confined space entry procedures into environments such as sewers, pits, tanks and other vessels, lift stations. Frequently encountered hazards include: Oxygen deficiency; combustible gas; Hydrogen Sulfide; Carbon Monoxide.

Municipal Departments – atmospheric hazards primarily encountered during confined space entry procedures into environments such as electrical vaults, manholes, storm drains, tunnels, pits and excavations. Frequently encountered hazards include Oxygen deficiency, combustible gas, Hydrogen Sulfide and Carbon Monoxide. Occasionally a specific process will involve the use of a particular contaminant such as Chlorine or Sulfur Dioxide. Presence of specific contaminants may be associated with confined space entry procedures or may exist in the general plant atmosphere.

Oil Production / Refining – atmospheric hazards may be encountered during confined space entry procedures or may be encountered in the general atmosphere associated with the refinery or production area. This is particularly true of Hydrogen Sulfide. Frequently, all employees assigned to a particular area will be equipped with a single sensor detector for the measurement of H2S. In vessels, tanks, pipelines, leaking valves, pits, excavations and containment berns, frequently encountered hazards include: Oxygen deficiency, combustible gas, Hydrogen sulfide, Carbon monoxide.

Chemical Plants – atmospheric hazards may be encountered during confined space entry procedures or may be encountered in the general atmosphere associated with the plant. The hazards encountered may be a direct consequence of the products being manufactured or handled. Frequently, all employees assigned to a particular area will be equipped with single sensor detectors for the measurement of a specific contaminant known to be potentially present. In vessels, tanks, pipelines, pits, leaking valves, excavations and containment berns frequently encountered hazards include: Oxygen deficiency, combustible gas, Hydrogen Sulfide, Carbon Monoxide, Sulfur Dioxide, Chlorine, Ammonia.

Power Stations – atmospheric hazards may be encountered during confined space entry procedures or may be encountered in the general atmosphere associated with the plant. The specific nature of the contaminants determined by the type of power station. Coal fired plants are especially associated with Sulfur Dioxide, while nuclear generating stations are especially associated with Oxygen deficiencies. In vessels, tanks, pipelines, pits, tunnels and bins, frequently encountered hazards include: Oxygen deficiency, combustible gas, Hydrogen Sulfide, Carbon Monoxide.

Construction – atmospheric hazards are generally encountered during construction procedures which are undertaken within confined spaces or excavations. In vessels, tanks, manholes, vaults, sewers, storm drains, pipelines, pits and excavations, frequently encountered hazards include: Oxygen deficiency, combustible gas, Hydrogen Sulfide, Carbon Monoxide.

Diesel Exhaust – contains a number of potentially dangerous contaminants. When diesel powered equipment is located inside a building or in a confined environment, contaminants include: Oxygen deficiency, Carbon Monoxide, Sulfur Dioxide, Nitric Oxide and Nitrogen Dioxide.

Propane Powered Equipment Exhaust – contains a number of potentially dangerous contaminants. When propane powered equipment is located inside a building or in a confined environment, contaminants include: Oxygen deficiency, combustible gas, Carbon Monoxide, Nitric Oxide and Nitrogen Dioxide.

Atmospheric Hazards in Confined Spaces

What is a confined space?

Confined space refers to any place, including any vessel, tank, container, pit, bund, chamber, cellar or any other similar space, which, by virtue of its enclosed nature, creates conditions that give rise to a likelihood of an accident, harm or injury of such a nature as to require emergency action due to the presence or reasonable foreseeable presence of : flammable or explosive atmospheres; harmful gas, fume or vapour; free flowing solid or an increasing level of liquid; excess of oxygen; lack of oxygen; excessively high temperature.

The key characteristics of a confined space are:

- The space must be substantially enclosed.
- There must be a risk of at least one of the above hazards occurring within the space.
- The risk of serious injury from the hazard must be created by virtue of the enclosed nature of the space.
- The potential injury must be serious and be such as to require emergency action to rescue the person(s) involved.

Atmospheric hazards in confined spaces are those that expose entrants to risk such as death, entrapment, injury or acute illnesses from one or more of the following:

- **Oxygen –** an atmospheric oxygen concentration below 19.5% (oxygen deficiency) or above 23.5% (oxygen enrichment). Oxygen deficiency is the leading cause of worker fatality during confined space entry. Excess oxygen in an environment can result in an increased risk of fire and explosion. Some materials, which do not burn in air, may burn vigorously or even spontaneously in an enriched oxygen atmosphere.
- **Combustible Gases –** a flammable gas or vapour (e.g. Methane, Propane, Gasoline) in excess of 10% of its lower explosive limit (LEL) yet remaining below the upper explosive limit (UEL). As an environment becomes contaminated with combustible gases or vapours, concentrations can eventually reach ignitable or explosive levels, resulting in the expulsion of hot gases and the disintegration of the structure.
- **Toxic Gases –** an atmospheric concentration of any toxic compound (e.g. Hydrogen Sulfide, Carbon Monoxide, Toxic Hydrocarbons) above the permissible exposure limit. Exposure limits concentrations should be considered in terms of:
  - **Ceiling -** the highest concentration of a toxic gas to which an unprotected worker should ever be exposed, even for a short time.

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- **Time Weighted Average (TWA) -** the maximum average concentration to which an unprotected worker may be exposed based on an 8 hour working day.
- **Short Term Exposure Limit (STEL) -** the maximum average concentration to which an unprotected worker may be exposed in any 15 minute interval during the day.

A toxic atmosphere may occur due to the presence or ingress of hazardous substances and may cause various acute effects including impairment of judgment, unconsciousness and death.

- **Flowing Liquid or Free Flowing Solids –** liquids or solids can flow into the confined space causing drowning, suffocations, burns and other injuries. Solids in powder form may also be disturbed in a confined space resulting in an asphyxiating atmosphere.
- **Excessive Heat –** the enclosed nature of a confined space can increase the risk of heat stroke or collapse from heat stress, if conditions are excessively hot. The risk may be exacerbated by the wearing of PPE or a lack or ventilation.

Monitoring Confined Spaces for Atmospheric Hazards

Gas detectors come in a variety of sizes, shapes and sensor configurations. For confined space work it is necessary to monitor for oxygen, combustible gases and toxics. Therefore, an instrument capable of dealing with these 3 hazards is necessary. Monitoring the air inside a confined space is required prior to entering. Testing a confined space for atmospheric hazards should be done remotely before entering and should be done in this order:

1. **Oxygen –** ensure that proper oxygen levels are present.
2. **Combustible Gases –** ensue that combustible gases are not present.
3. **Toxic Gases –** ensure that toxic gases are below the permissible exposure limit.

In a confined space it is important to take samples at the top, middle and bottom to locate varying concentrations of gases and vapours, or as the design of the space dictates. Highly concentrated gases can accumulate at the top or bottom of a confined space depending on whether they are less or more dense than air. Dilute gases and vapours in the parts per million (ppm) range distribute evenly throughout a confined space. It is especially important to sample at a distance from the opening because air intrusion near the entrance can give a false adequate Oxygen presence.

When the remote air monitoring is complete and the area is safe for entry, confined space entry permits should be completed and followed. After the initial entry, monitoring the air in the confined space should be continuous. A confined space entry attendant or hole watch should carry out the continuous monitoring. Conditions in a confined space can change without warning, due to leakage, toxic vapour release or disturbing the contents of the space.

Sensor Technology

Sensors and their capabilities are the single most important factor when choosing a gas detector.

Combustible Gas Sensors

Catalytic Combustible Gas Sensors – detect combustible gases by causing an actual combustion of gases within the sensor chamber. These work best in concentrations between 1,000 and 50,000 ppm. They do not measure trace amounts of gas (under 200 ppm) and therefore cannot be used to determine toxic levels.

Metallic Oxide Semiconductor (MOS) Combustible Gas Sensor – a sensor with a long operation life (3 – 5 years). It is very rugged and will recover from high concentrations of gas that may damage other types of sensors. The MOS sensor may respond to many VOCs, HFCs and solvents but is not specific to any single compound. The readings can be affected by humidity and water vapour condensation.

Infra-Red Combustible Sensors – work well in low oxygen levels or acetylene atmospheres. These sensors work by reflecting light off a mirror and measuring the amount of light absorbed during refraction. Infra-red sensors typically require a constant flow across the sensing assembly and may be slow to clear from alarm. They are unable to detect Hydrogen. An infra-red sensor calibrated for a simple hydrocarbon such as Methane or Ethane will not be accurate for vapour or higher molecular weight hydrocarbons, solvents or fuels.

Toxic Sensors

Electrochemical (Wet Chem) Toxic Sensors – react to a specific chemical (substance). Chemically specific sensors are available for up to 30 different gases including Chlorine, Ammonia, Carbon Monoxide, Carbon Dioxide, Nitrogen Dioxide, Nitric Oxide, Hydrogen Cyanide, Hydrogen Sulfide and Sulfur Dioxide. The manufacturer's technical information will indicate what sensors are available for their unit. These sensors are very accurate for the substance they will react to and can measure large and small quantities. Typically these sensors have a life span of 1 year for many toxic gases and up to 2 years for Hydrogen Sulfide and Carbon Monoxide. As with all sensors, these have their limitations. The electrolytic fluid can freeze when left in temperatures lower than 0°C. Some chemical sensors may be adversely affected by altitude and they may be pressure sensitive.

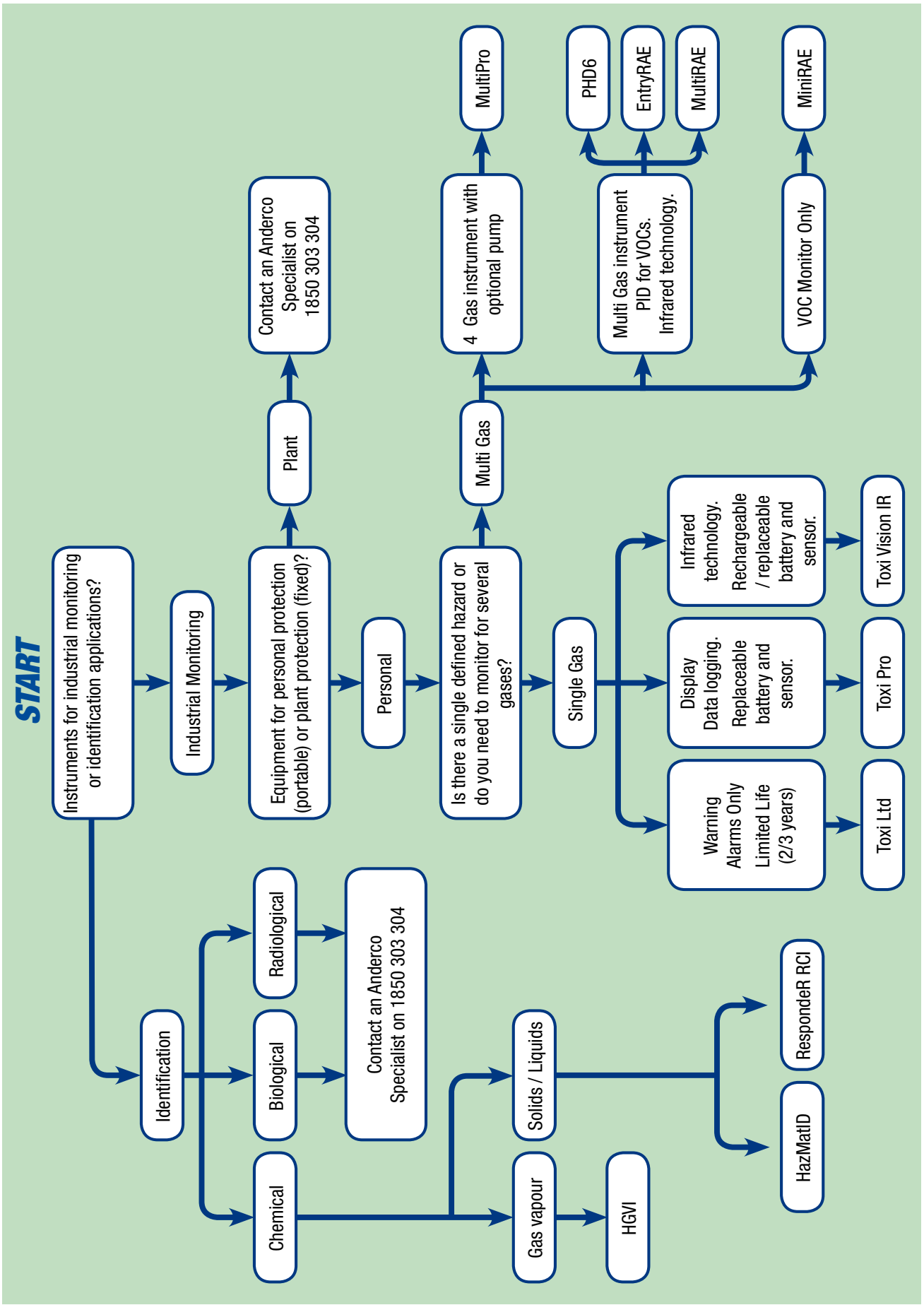
Metallic Oxide Semiconductor (MOS) Toxic Broad Range Gas Sensors – capable of reacting to low ppm levels of a wide range of toxic gases including Carbon Monoxide, Hydrogen Sulfide, Ammonia, Styrene, Toluene, Gasoline and many other hydrocarbons and solvents. MOS sensors cannot detect Carbon Dioxide or Sulfur Dioxide. This sensor is incapable of indicating the gas encountered or the concentration, only that the atmosphere may be hazardous to your health.

Photo Ionisation Detectors (PIDs) - a sensitive, continuous, broad-band monitor that measures volatile organic compounds (VOCs) and other toxic gases in low concentrations from ppb (parts per billion) up to 10,000 ppm (parts per million or 1% by volume). The largest group of compounds measured by a PID are the Organics: compounds containing Carbon atoms, including: Aromatics (compounds containing benzene ring, including benzene, toluene, ethyl benzene and xylene); Ketones and aldehyes (compounds with a C=O bond including acetone, mehtyl, ehthyl ketone and acetaldehyde); Amines and amides (carbon compounds containing nitrogen, such as diethylamine); Chlorinated hydrocarbons (trichloroethylene, perchloroethylene); Sulfur compounds (mercaptans, sulfides); unsaturated hydrocarbons (such as butadiene and isobutylene); Alcohols (such as isopropanol and ethanol); Saturated Hydrocarbons (such as butane and octane). In addition, PIDs can be used to measure some compounds without carbon including: Ammonia, Semiconductor gases (Arsine, Phosphine), Hydrogen Sulfide, Nitric Oxide, Bomine and Iodine. PIDs do not measure: Radiation, Air (N_2, O_2, CO_2, H_2O), Common toxics (CO, HCN, SO_2), Natural gas (methane, ethane) Acid gases (HC1, HF, HNO_3), Others (Freons, Ozone, Hydrogen Peroxide), Non-volatiles (PCBs, greases).

Oxygen Sensors

Oxygen sensors are the only true chemically-specific sensors. They are similar to the Wet Chem sensors. They are also susceptible to freezing, are sometimes affected by altitude and have a nominal operational life of 1 to 2 years. Never use an Oxygen sensor to detect toxic gases. It is true that a toxic gas will displace Oxygen in a confined space. However, it takes 60,000 ppm of any gas to lower the Oxygen from 20.9% (normal) to 19.5% (alarm point). 60,000 ppm of any toxic gas will kill you.

HOW TO CHOOSE YOUR MONITOR



Gas Monitor Selection Guide

	Biosystems Mulitpro (Q01002)	Biosystems ToxiVision IR (Q01003)	Biosystems ToxiLtd (Q02001)	Biosystems ToxiPro (Q01004)	Biosystems PhD6 (Q01010)	Rae Systems EntryRAE (Q01007)	Rae Systems MiniRAE (Q01008)	Rae Systems MulitRAE (Q01009)
Instrument Type	Multi sensor, confined space gas detector. Rechargeable / replaceable battery & sensor	Single sensor gas detector using infrared technology. Rechargeable / replaceable battery & sensor	Single sensor gas detector. 2 or 3 year limited life.	Single sensor gas detector. Replaceable battery & sensor	Multi sensor 6 gas detector, with VOC detector. Rechargeable / replaceable battery & sensor	Multi sensor 5 gas detector, with VOC detector. Rechargeable / replaceable battery & sensor	Hand-held VOC monitor. Rechargeable / replaceable battery & sensor	5 Gas monitor with VOC detector. Rechargeable / replaceable battery & sensor
Number of Gases Detected	4	1	1	1	5+VOC	4+VOC	VOC	4+VOC
Number of Sensors Available	5	2	4	11	19	5	1	12
Dimensions	11.4 x 6.8 x 4.3cm	8.9 x 6.4 x 3.25cm	8.4 x 5.5 x 2.9cm	8.4 x 5.5 x 2.9cm	17.8x 7.6 x 5.1cm	15 x 8.3 x 4.8cm	25.2 x 7.6 x 6.4cm	12 x 7.6 x 4.8cm
Weight	280g	190g	105g	110g	454g	567g	738g	453g
Housing	Polycarbonate case with rubber overmould.	Chrome metal plated case immune to RFI (to 40V/m).	Clear polycarbonate with thermal swivel elastic overmould	Clear polycarbonate with thermal swivel elastic overmould	Polycarbonate case with rubber overmould.	Rubber case	Yellow rubber case.	Yellow rubber case.
Durability (IP Rating)	IP65 water and dust rating.	IPX7 water and dust rating.	IP65 / IP67 water and dust rating.	IP65 / IP67 water and dust rating.	IP65 water and dust rating.	IP55 water and dust rating.	IP65 / IP67 water and dust rating.	IP55 water and dust rating.
Accessories Included	Calibration adapter, hose, probe (with dust and water filters), charger and plug, operators quick guide and quick reference card.	Calibration adapter, hose, probe (with dust and water filters), charger and plug, operators quick guide and quick reference card.	Calibration adapter, hose, operators quick guide and quick reference card.	Calibration adapter, hose, probe (with dust and water filters), charger and plug, operators quick guide and quick reference card.	Calibration adapter, sample draw hand pump, hose, probe (with dust and water filters), charger and plug, operators quick guide and quick reference card.	Calibration adapter, computer interface cable, user manual, ProRAE Studio software package, charging cradle, shipping case.	Integrated flashlight, user manual, quick reference guide, Pro RAE Studio software package.	Calibration adapter, training CDROM, operation and maintenance manual, alkaline batter adapter, 3-inch inlet probe.
Battery	Available with either Li-Ion or Alkaline battery pack.	Available with either NiMH or Alkaline battery pack.	2/3 year life, including 7 day shut down mode.	9000 hours use.	Available with either Li-Ion or Alkaline battery pack.	Rechargeable, replaceable Li-Ion battery pack. Alkaline battery adapter. Charging cradle doubles as external battery charger.	Rechargeable, replaceable Li-Ion battery pack. Alkaline battery adapter.	Interchangeable, rechargeable Li-Ion and alkaline battery packs.
ATEX Approved	II 2 G Ex ia d IIC T4	II 2 G Ex ia d IIC T4	II 2 G Ex ia d IIC T4	II 2 G Ex ia d IIC T4	II 2 G Ex ia d IIC T4	II 2 G EEx ia d IIC T4	II 2 G EEx ia d IIC T4	II 2 G EEx ia d IIC T3 & T4

	Biosystems Mulitpro (Q01002)	*Biosystems ToxiVision IR (Q01003)*	*Biosystems ToxiLtd (Q02001)*	*Biosystems ToxiPro (Q01004)*	*Biosystems PhD6 (Q01010)*	*Rae Systems EntryRAE (Q01007)*	*Rae Systems MiniRAE (Q01008)*	*Rae Systems MulitRAE (Q01009)*
FEATURES								
Audible / Visible / Vibrating Alarm	●	●	●	●	●	●	●	●
Display Backlight	●	●		●	●	●	●	●
One Button Operation / Calibration	●	●	●	●	●	3 BUTTON	●	●
Eventlogging	●	●	●	●	●	●	●	●
Datalogging	●	OPTIONAL		●	OPTIONAL	●	●	●
SENSOR OPTIONS								
LEL – Combustible Gas	●				●	●		●
Oxygen (O2)	●		●	●	●	●		●
Carbon Monoxide (CO)	●		●	●	●	●		●
Hydrogen Sulphide (H2S)	●		●	●	●	●		●
CO/H2S (DuoTox)	●				●			
CH4 (Methane)					●			
Carbon Dioxide (CO2)		●			●			
Sulphur Dioxide (SO2)			●	●	●			●
Chlorine (Cl2)				●	●			●
Chlorine Dioxide (ClO2)				●	●			
Ammonia (NH3)				●	●			●
Nitric Oxide (NO)					●			●
Ntiric Dioxide (NO2)				●	●			●
Phosphine (PH3)				●	●			●
Hydrogen Cyanide (HCN)				●	●			●
CO-H				●	●			
PID - VOCs					●	●	●	●
Carbon Dioxide Infra-red (IR-CO2)					●			
Methane Infrared (IR-CO4)		●			●			

Sampling Methods

In confined space testing it is important that the operator know how the sensor comes in contact (operation) with the atmosphere. There are 3 primary means of exposing the sensor to the atmosphere: sample draw, diffusion, and detachable remote diffusion sensor assembly. There are strengths and weaknesses in all systems. Selection should be based on need, not availability.

Sample Draw

This is the most common form of sampling a confined space. The advantage is that monitoring is performed outside the space. With a sample draw system, a pump moves the sample from the atmosphere and draws it through a hollow tube into the sensor. The pump can be either a hand aspirator or an internal motorised sample pump. Drawing the sample to the detector protects the tester by eliminating the need to enter the space and limits any movement that may create a spark. A disadvantage of the manual sample draw method is the effort involved in moving the air sample along the tube to the sensor.

Sensor Operation

Most gas detector sensors operate by diffusion. Diffusion works by air being absorbed into the sensor cell. Electronic gas detectors rely heavily on diffusion sampling. The atmosphere must be brought to the gas sensors by sample draw (aspiration) or by lowering the gas detector into the atmosphere. Some manufacturers offer a detachable, remote sensor assembly. Advantages of this technology include the lack of pumps and moving parts, much faster response times, with no potential of diluted readings. The sample method is still diffusion but the sensors are lowered into the atmosphere to be tested. Once the atmosphere has been tested by aspiration and/or remote sensors, the gas detector can be worn by the worker for the duration.

Calibration / Bump Test

All portable gas detectors should be calibrated according to the manufacturer's recommendations. Failing to calibrate or bump test a gas detector on a regular basis is an invitation to disaster. Sensors and/or electronics can fail so it is prudent to check your instrument on a regular basis.

Bump Test – a bump or field test is the application of a known gas concentration in excess of the calibrated alarm point of the instrument. When the gas is applied to the detector it should trip the alarm point to demonstrate that the instrument is functioning correctly. If it does not then a re-calibration is necessary. Multiple gas mixtures are available that allow users you perform a simultaneous bump test with one canister of gas. It is good practice to bump test at least once a week.

Calibration – calibration should be performed as per the manufacturer's recommendations. Calibration is performed with a known gas concentration that can be at the exact alarm point, or at a higher concentration where the set point can be adjusted. This varies between manufacturers. If you are bump/field testing on a regular basis you can wait until that test indicates that a re-calibration is required. If bump/field tests are not performed then the unit should be re-calibrated on a regular basis. Re-calibrating every 3 to 6 months is common practice.

Using Fixed & Portable Gas Detectors

There are 2 basic options when it comes to atmospheric monitoring:

1. Use of portable gas detectors assigned to employees who enter the affected area.
2. Us of continuous "fixed" detection systems which are permanently installed in the affected area and functional 24 hours per day.

Sometimes, the best approach involves combined use of both fixed and portable monitors. In deciding which approach, it is essential to consider the following:

- **The atmospheric hazards potentially present –** ensure you have a clear understanding of the potential hazards. Understanding the dangers associated with specific contaminants is critical to devising an appropriate monitoring programme.
- **The source of the atmospheric hazards –** establish the source of potential hazards, determine if the hazards are associated with work being performed, bacterial action, products in use or the associated industrial processes. Watch out for sources remote from the area where work is actually being performed.
- **Hazards that are chronically present –** determine whether the hazards are present all of the time or only when certain procedures, activities, and/or products are in use. Hazards known to be chronically present in areas where employees are routinely required to enter without special precautions should be monitored on a continuous basis.
- **The physical nature of the area affected –** determine whether the entire facility if affected or only certain areas. Determine if the affected areas are outdoors and subject to good ventilation, indoors or in confined areas which may prevent rapid dispersal of contaminants. Fixed detection systems are ideal for 24-hour "sentry" applications.
- **The amount of time required for employees to safely leave the affected area –** affected areas may be congested with equipment, machinery or other obstacles to safe evacuation. Monitoring programmes should be structured to allow employees adequate time to "self rescue". In other words, employees must be alerted to hazardous conditions before they become life threatening, and while they have enough time to safely evacuate the affected area. Fixed detection systems are frequently used to provide an alarm for general evacuation of an affected area.
- **If the affected area must be maintained safe for continuous employee occupancy –** consider whether the area is secured against unauthorised entry or is one which is routinely entered without special precautions being taken. Atmospheric hazards in areas routinely entered on an uncontrolled basis should be monitored on a continuous basis.
- **The level of control over activities in the affected area –** the lower the level of control over activities in the affected area, the more desirable it may be to install a continuously operational, fixed detection system.
- **The level of training provided to potentially affected employees –** one of the advantages of installing a fixed detection system is that employees in the affected area are not involved in the day-to-day operation of the system. Therefore, all they need to do is follow company procedures in the event an alarm is sounded. Employees issued with individually assigned gas detectors should be trained on how to effectively use and routinely maintain the equipment provided.

HOW CAN ANDERCO HELP?

A SERVICE BASED SOLUTION

Finding the most appropriate gas monitoring solution for your facility requires a thorough analysis of numerous site specific circumstances. Anderco Safety can help you to select the solution that is most suitable to your risk.

Working in close collaboration with gas monitoring equipment manufacturers, Anderco Safety has the expertise in gas monitoring and detection to offer a range of services and technology for an all-inclusive gas monitoring program guaranteed to deliver the capabilities you need most. By all-inclusive we mean a solution that meets the total requirements for providing gas monitors for worker protection, training on the equipment, calibration convenience, maintenance, repairs and upgrades.

Anderco Safety can supply you with a reliable, user friendly gas monitoring solution and personalised service ideally suited to your company's specific needs – at the lowest cost and most convenience possible:

- A consultancy Service – designed to help you identify potential hazard situations where combustible gas, toxic gas or oxygen deficiency is a concern.
- Robust, ATEX certified, user friendly products – from small personal gas monitors to complete systems integration.
- The convenience of on-site calibration for the reliable performance of monitoring instruments.
- Extensive after sales support – training, equipment maintenance, repair and replacement.
- Training – on equipment supplied by Anderco and training tools for product operation and routine maintenance.
- Routine maintenance service – for scheduled and unplanned repairs.
- Regular instrument upgrades.

For full details on the gas monitoring service available, contact your Anderco Safety representative.